

## B. RAJKOT-JAMNAGAR-VADINAR CORRIDOR

### B.3 REVIEW OF PRE-FEASIBILITY STUDIES

#### B.3.1 Submittal Referred To

1. The study on 'Preparation of Pre-feasibility Study and Bidding Documents for Four Laning and Strengthening of Rajkot - Jamnagar – Vadinar Road was given to two consultants.
2. The report made available on Rajkot – Jamnagar, is the Interim Report, submitted in 2001. Therefore, review of this report has been made. However in case of Jamnagar – Vadinar the report made available and reviewed was Draft Final Report.

#### B.3.2 Traffic Studies and Forecast

##### B.3.2.1 Base Year Traffic Volumes

3. On Jamnagar – Vadinar section, the traffic volume surveys have been conducted at 7 locations. The base year traffic volumes have been established as given in Table B.3-1.

**Table B.3-1: Base Year Traffic Volume on Jamnagar–Vadinar Corridor**

Location	ADT in Vehicles	ADT in PCUs
Hotel Regal Palace	10612	19383
Vadinar Junction	5208	9063
Near Sikka Junction	5808	7968
Jhakar Village	1907	2725
Shree Parotha House	4426	12378
Lalpur Junction	5341	10345
Kalavad Junction	4046	10177

4. On Rajkot – Jamnagar corridor, traffic levels recorded at three locations are as given below:

Location	Chainage	Average Daily Traffic		Commercial Vehicles	
		Vehicles	PCU	PCU	%
Dhrol	Km 49.2	4616	8296	6246	75
Phalla	Km 63.3	5184	9180	7016	76
Khijadia	Km 78.3	8301	13870	10000	72

##### B.3.2.2 Projected Traffic

5. Four methods of traffic projection have been tried in the study on Jamnagar – Vadinar, and the resultant growth rates of traffic presented, therein. The finally selected traffic growth rate as noted in the study “uses a mixture of subjective judgements and quantitative methods” . The traffic growth rates adopted by mode are as under:

Section No.	Section Name	Annual Traffic Growth Rate (%)
1	Jamnagar – Vadinar Section on SH-25	6%
2	Jamnagar Bypass	6%
3	Vadinar Approach	5.5%
4	Sikka Approach	5.5%

6. Using the above growth rates, the future normal traffic on the project corridor has been estimated (as given in Table B.3-2).

**Table B.3-2: Projected Normal Traffic in PCUs (Fast and Slow Vehicles)**

Section Name	2006	2010	2020	2030
Jamnagar Bypass (Rajkot end) to Kalavad Junction	15916	20093	35984	64442
Kalavad Junction to Lalpur Junction	16148	20387	36510	65383
Jamnagar Bypass (Vadinar end) to Lalpur Junction	20365	25711	46044	82457
Jamnagar Bypass (Vadinar end) to Sikka Junction	29818	37644	67415	120731
Sikka Junction to Vadinar Junction	14195	17921	32094	57476
Sikka Approach	12132	15030	25673	43853
Vadinar Approach	4107	5088	8691	14846

7. The contribution of the existing industries to the total traffic on the project corridor has been assessed along with induced traffic. The industries considered are Reliance Petro Chemicals Ltd., Essar Refinery Limited and Gujarat State Fertilizers and Chemicals. The total expected traffic on the corridor, by section, therefore has been summarised as in Table B.3-3.

**Table B.3-3: Projected Total Traffic in PCUs  
(Normal + Development Traffic + Induce Traffic)**

Section Name	2010	2020	2030
Jamnagar Bypass (Rajkot end) to Kalavad Junction	29818	50476	91342
Kalavad Junction to Lalpur Junction	30127	51087	92550
Jamnagar Bypass (Vadinar end) to Lalpur Junction	35722	62770	124171
Jamnagar Bypass (Vadinar end) to Sikka Junction	48261	86960	163514
Sikka Junction to Vadinar Junction	22881	41303	77743
Sikka Approach	15030	25673	43853
Vadinar Approach	9243	13306	20587

8. For the section between Rajkot to Jamnagar, the report available for review, as already mentioned, is the interim report, which did not contain traffic forecast<sup>1</sup>.

### B.3.2.3 Tollable Traffic

9. Tollable traffic has been estimated under following categories:

- Travel distance up to 20 km
- Travel distance from 20 to 35 km
- Travel distance greater than 35 km

10. This traffic has been also been assessed under three conditions:

- Normal Traffic
- Normal + Development Traffic
- Normal + Development + Induced Traffic

11. Table B.3-4 presents the normal + development linked tollable traffic

**Table B.3-4: Tollable Traffic (in Vehicles)**

<sup>1</sup> Tollable traffic is also not estimated and reported in the Interim Report of Rajkot Jamnagar Corridor

Year	Travel Distance (km)		
	< 20 km	20 – 35 km	> 35 km
2006	7243	2465	16685
2010	8920	2929	20710
2020	15300	4695	36021
2030	26726	7856	63440

**B.3.3 Project Cost**

12. The estimated preliminary cost of Jamnagar – Vadinar road, was based on the following engineering surveys :

- Visual assessment of existing pavement and bridges
- Benkelman Beam Survey
- Pavement Riding Quality Survey
- Material Survey
- Highway Alignment Survey

13. Based on the assessed traffic levels, it has been felt that four-laning of the existing road is justified. The preliminary cost of four laning of the project corridor has been estimated as follows:

Section of Road	Works	Base Cost (Rs. in Crores)
Jamnagar – Vadinar	Widening and strengthening of roads and bridges	112.09
Jamnagar Bypass	Widening and strengthening of roads and bridges	45.43
Sikka Approach	Strengthening of roads and bridges	5.99
Vadinar Approach	Strengthening of roads and bridges	8.26
<b>Total Cost</b>		<b>171.77</b>

14. Interim Report on Rajkot to Jamnagar presented some analysis of engineering surveys only. The project cost was not estimated and/or documented in the report.

**B.3.4 Environmental and Social Assessment**

15. The report on Jamnagar to Vadinar does not include these aspects.

16. The interim report on the Rajkot to Jamnagar section of the project corridor presents a very brief report on the social and environmental aspects, primarily based on the quick screening and secondary data. It includes the following :

- The intermediate influence area of the project corridor is reported to be predominantly agricultural and industrial. The land is fertile, and agriculture forms the major economic activity in the district.
- Number of major villages and towns fall enroute to be about 19. It is reported that development of road may lead to increased noise levels and air pollution<sup>2</sup>. Small temples and mosques have been observed to be located within the right of way of the project road<sup>3</sup>.

<sup>2</sup> Sufficient measures in design and EMAP need to be incorporated.

<sup>3</sup> However the land acquisition is not reported to be an issue of concern.

**B.3.5 Economic Analysis**

17. Economic analysis for Jamnagar to Vadinar road has been undertaken on the principles set out in the IRC Standards – SP-38 ‘Manual for Road Investment Decision Model’, and SP-30 ‘Manual on Economic Evaluation of Highway Projects in India’. The EIRR for the project have been estimated by section. The results have been given in Table B.3-5.

**Table B.3-5: Results of Economic Analysis**

Section	Without Time	With Time
Jamnagar – Vadinar Section on SH-25	22%	49%
Jamnagar Bypass	26%	29%
Vadinar Approach	19%	22%
Sikka Approach	19%	19%

18. The sensitivity analysis reflects that the project is viable in the worst situation of 15% increase in project cost along with 15% reduction in benefits.

19. The Interim Report on Rajkot – Jamnagar did not contain or reported anything on the economic analysis.

**B.3.6 Financial Analysis**

20. The financial analysis for Jamnagar – Vadinar project has been undertaken for following scenarios:

- Scenarios 1 – Four laning of Jamnagar – Vadinar Road, Jamnagar Bypass and strengthening of the approaches to Vadinar and Sikka.
- Scenarios 2 – Four laning of Jamnagar – Vadinar Road and Jamnagar Bypass, but excluding approach roads to Vadinar and Sikka.
- Scenarios 3 – Four laning of Jamnagar – Vadinar Road with strengthening of Jamnagar Bypass and approaches to Vadinar and Sikka.

21. The landed project cost by the three scenarios are:

- Scenarios 1 – Rs. 244.807 crores
- Scenarios 2 – Rs. 224.49 crores
- Scenarios 3 – Rs. 211.10 crores

22. With debt-equity ratio at 7:3 and rate of interest at 14% p.a., the results of the financial analysis are as given in Table B.3-6. The analysis period has been taken as 30 years.

**Table B.3-6: Presents of Financial Analysis**

Traffic Options	FIRR by Scenario		
	1	2	3
Normal Traffic	15%	15%	17%
Normal + Development	17%	16%	18%
Normal + Development + Induced	18%	17%	19%

23. The findings of the analysis have been stated as under :

- Project should be bid for a long concession priced of 30 years or longer.
- Traffic and cost are critical factors for project viability.
- The toll structures to be adopted should be that recommended by the Ministry, and not lower. The bidders should be asked to bid for different lengths of concession priced, with maximum being 35 years.

24. Suggestions have been made to enhance project viability:

- Traffic or revenue guarantees by GoG.
- GoG to provide initial capital support by way of a subordinate debt, which can be repaid after the senior lenders' loan is paid off.
- Major industries in the area to participate in the project.

25. Financial analysis of the Rajkot – Jamnagar section was not undertaken and/or anything was reported in the report.

## B.4 OUR EFFORTS AND FINDINGS

### B.4.1 Salient Corridor Characteristics

26. Rajkot – Jamnagar – Vadinar, SH-25, traverses over 126 km in Saurashtra region of the state of Gujarat. The corridor takes off from Rajkot, and traverses through Dhrol, Falla, Jamnagar city, Reliance refinery and ends at Vadinar Port (Figure B.4-1).

27. Recognising the importance<sup>4</sup> the R&BD has been making investments on this strategically important corridor. The widening and strengthening works between Rajkot to start point of Jamnagar bypass; and end point of Jamnagar bypass to start point of approach to Vadinar port, are nearing completion under the GSHP. However, on Jamnagar bypass, periodic renewal of pavement with heavy maintenance has been completed under the third year Road Maintenance Component of GSHP.

### B.4.2 Traffic Studies and Forecast

#### B.4.2.1 Traffic Survey Locations

28. The classified traffic volume survey (at four locations), Origin-Destination survey (at 2 locations) and axle load survey (at 1 location) as per the details given below (Map given as Annexure B-1) were conducted to establish base year (2006) traffic volume level and desire pattern.

Location	Chainage	Survey Detail	Survey Duration
<b>CORRIDOR 1: Km 3 to Km 125.5 Rajkot-Jamnagar-Vadinar</b>			
Near Paddhari	at 23/000 km	Traffic Volume	7 Days

<sup>4</sup> A number of heavy industries are located along the corridor as well as in the influence area – to name a few, these are Reliance oil refinery, Sikka cement factory, GSFC, ESSAR, etc.

		Origin Destination	1 Day
		Axle Load	1 Day
Kizadia Bus Stop	at 78/500 km	Traffic Volume	7 Days
Near RTO Check Post	at 94/00 km	Traffic Volume	3 Days
Sikka Bus Stop	at 111/00 km	Traffic Volume	7 Days
		Origin Destination	1 Day

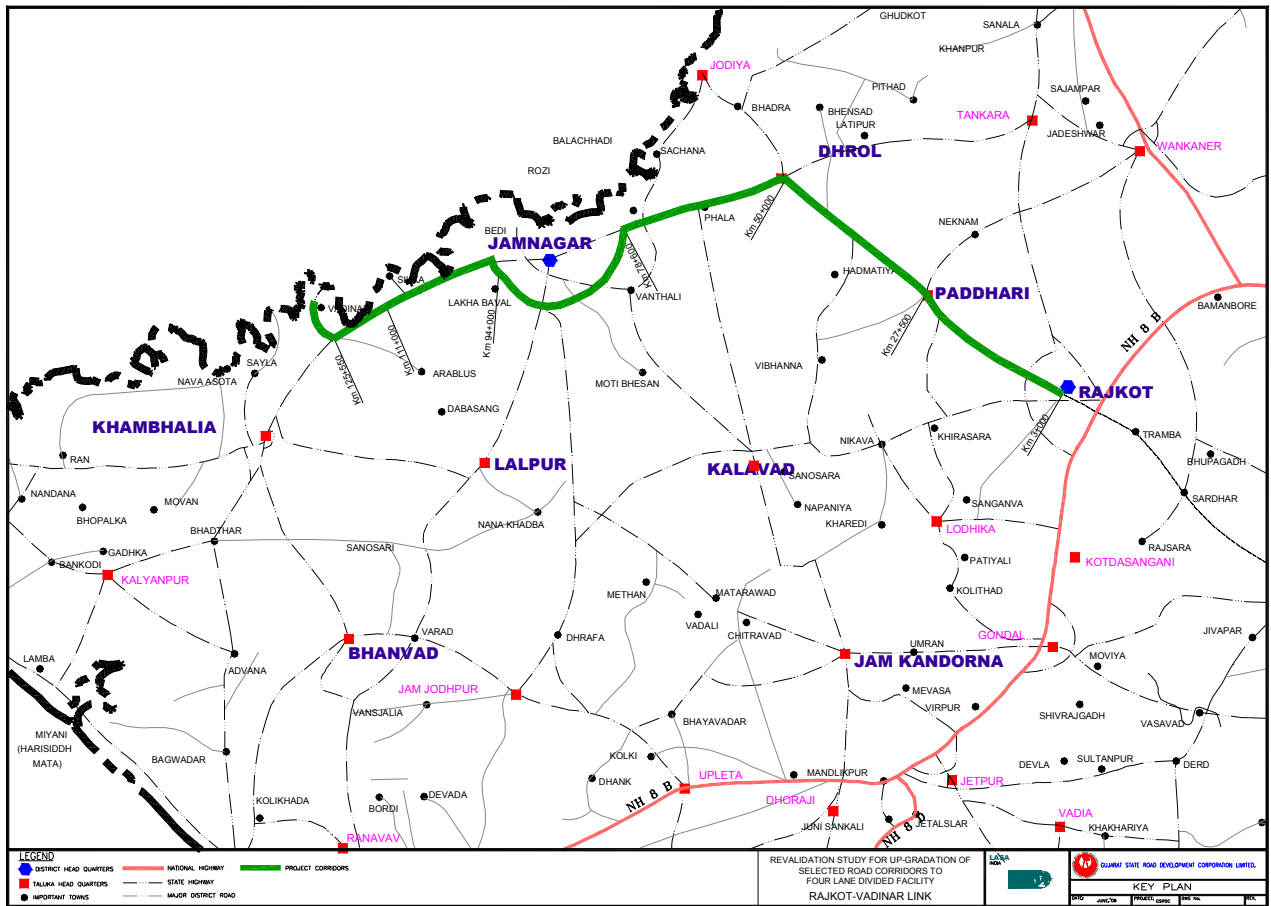


Figure B.4-1: PROJECT KEY PLAN

**B.4.2.2 Traffic Volume Levels -2006**

29. The average daily traffic volume levels recorded by sections on project corridor (Table B.4-1-(1) to B.4-1-(3)) were converted annual average traffic volume levels<sup>5</sup>. The base year traffic levels are as given under:

**Table B.4-1: Rajkot-Jamnagar-Vadinar Traffic volume levels by sections**

**Table B.4-1-(1): Average Daily Traffic Volume (ADT in VEHs)**

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw/ Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn	Others	ADT (VEH)
Rajkot-Jamnagar - Vadinar	Rajkot-Dhrol	3347	1192	246	2590	175	656	766	1652	1612	500	99	27	35	5	1	4	12908
	Dhrol-Jamnagar	2724	1156	275	2238	249	813	587	1806	2456	640	86	24	50	6	3	7	13122
	Jamnagar-Bypass	1311	343	53	887	20	39	162	735	1638	435	49	16	90	5	2	2	5787
	Jamnagar-Vadinar	2187	1033	491	3632	582	962	308	2860	3380	822	119	51	13	3	3	38	16481

**Table B.4-1-(2): Annual Average Daily Traffic Volume (AADT in VEHs and PCU)**

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw / Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo / LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn	Others	AADT (VEH)	AADT (PCU)
Rajkot-Jamnagar - Vadinar	Rajkot-Dhrol	3012	1073	221	2331	158	591	690	1487	1451	450	89	24	32	5	1	3	11618	19582
	Dhrol-Jamnagar	2452	1041	247	2015	224	732	528	1625	2211	576	77	22	45	6	3	6	11810	22538
	Jamnagar-Bypass	1180	309	47	798	18	35	146	662	1475	392	44	14	81	5	2	2	5209	10570
	Jamnagar-Vadinar	1968	930	442	3269	524	865	277	2574	3042	740	107	46	12	2	3	34	14833	30649

<sup>5</sup> Seasonal Correction factor of 0.9 was applied

**Table B.4-1-(3): Traffic Composition**

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn Vehicles	Others	AADT (VEHs)
Rajkot-Jamnagar-Vadinar	Rajkot-Dhrol	25.9%	9.2%	1.9%	20.1%	1.4%	5.1%	5.9%	12.8%	12.5%	3.9%	0.8%	0.2%	0.3%	0.0%	0.0%	0.0%	100%
	Dhrol-Jamnagar	20.8%	8.8%	2.1%	17.1%	1.9%	6.2%	4.5%	13.8%	18.7%	4.9%	0.7%	0.2%	0.4%	0.0%	0.0%	0.1%	100%
	Jamnagar-Bypass	22.6%	5.9%	0.9%	15.3%	0.4%	0.7%	2.8%	12.7%	28.3%	7.5%	0.8%	0.3%	1.6%	0.1%	0.0%	0.0%	100%
	Jamnagar-Vadinar	13.3%	6.3%	3.0%	22.0%	3.5%	5.8%	1.9%	17.4%	20.5%	5.0%	0.7%	0.3%	0.1%	0.0%	0.0%	0.2%	100%

**Table B.4-1-(4): Peak Hour share of Traffic by Sections and Mode types**

Corridor Name	Link Name	Peak hour	Sc/Mc	Auto Rickshaw /Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn Vehicles	Others	AADT (VEHs)	AADT (PCUs)
Rajkot-Jamnagar-Vadinar	Rajkot-Dhrol	19:00-20:00	279	78	20	201	16	38	43	91	79	25	8	2	5	0	0	0	885	1313
	Dhrol-Jamnagar	22:00-23:00	90	29	10	83	10	35	39	120	149	50	3	0	1	0	0	0	619	1397
	Jamnagar-Bypass	21:00-22:00	113	20	5	86	3	2	10	43	93	27	2	0	1	0	0	0	405	734
	Jamnagar-Vadinar	07:00-08:00	164	91	58	193	53	79	10	186	153	48	2	3	0	0	0	0	1040	2029

**Table B.4-2: Traffic Volume-Salient Aspects**

S. No.	Section	Traffic Volume			Peak hour Factor
		ADT (veh)	AADT (veh)	AADT (PCU)	
1	Rajkot-Dhrol	12,908	11,618	19,582	1.68
2	Dhrol-Jamnagar	13,122	11,810	22,538	1.91
3	Jamnagar Bypass	5,787	5,209	10,578	2.03
4	Jamnagar-Vadinar road	16,841	14,833	30,649	2.07



30. Traffic composition (Table B.4-1-(3)) reveals that goods traffic share vary from 35% to 45% or even more. It is evident from PCU factor derived. The peak traffic share was observed to be varying very marginally by sections. It is observed to be about 6.5% across the study sections (Table B-4.1-(4)). The details of traffic volume data collected are given in Annexure B-2.

31. The pre-feasibility study traffic levels were not revisited, as the comparison<sup>6</sup> could not be made, as locations for conduct of surveys were different. It is important to note in this context that there has been growth in traffic levels. Compared Updated SOS<sup>7</sup> traffic volume levels of 2005, traffic volume levels recorded on project corridor were high. From this what one can't infer is that – the project corridor is important, recording volume levels, this it is evident that traffic on the corridor is growing between moderate to high growth rates. This is largely because of high component of commercial traffic on the project corridor.

#### B.4.2.3 Traffic Desire Pattern

32. The Origin-Destination data by mode was analysed. The trip ends by mode type were seen with respect to immediate influence area zones, traffic originating and terminating within Gujarat state and traffic which has one of the trip ends (either origin or destination) outside Gujarat.

33. The traffic zoning scheme and maps are placed at Annexure B-3.

34. The mode wise break-up of trips internal to Gujarat and external (to and from Gujarat) is given at Table B.4-3. The desire line diagrams shown in Maps B.4-1 & B.4-2 suggest very high proportion of tollable amongst the tollable modes of traffic.

**Table B.4-3: Break-up of trips internal to Gujarat and external (to and from Gujarat)**

Section		Cars			Goods Traffic		
		Both Trip ends on Corridor	With one trip ends on Corridor-Second generated in Gujarat	With one trip end outside Gujarat	Both Trip ends on Corridor	With one trip ends on Corridor-Second generated in Gujarat	With one trip end outside Gujarat
Rajkot-Dhrol	Vehicles		2835			3651	879
	%		100%			80.5%	19.5%
Dhrol-Jamnagar	Vehicles		2489	24	1579	3044	866
	%		99%	1%	28.8%	55.5%	15.7%
Jamnagar-Vadinar	Vehicles	2	3975	146	487	5639	1244
	%	.5%	<sup>8</sup> 96%	3.5%	6.6%	76.5%	16.9%

<sup>6</sup> The value reported were ADT not AADT. Further Locations were different.

<sup>7</sup> Updated SOS was done in 2005 under GSHP.

***Draft Final Report***

*Revalidation Study and Overall Appraisal of the Project for  
Four-Laning of Selected Road Corridors in the State of Gujarat*

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#### **B.4.2.4 Traffic Forecast**

35. In addition to above efforts, the traffic volume on the project corridor is forecasted under various considerations. The traffic forecast in updated SOS was based on the assumption that the state shall implement the development of roads and there shall be no imposition of road user charges. In these conditions the normal traffic shall grow at fairly high growth rates. Further, to this the latent demand for travel will be realised leading to induced and generated traffic levels. If projects are implemented under commercial format, their perceived to be disutility by the road users, as they need to pay user fee. This phenomenon is observed across several road projects in India, if an alternate route is available. The project roads are state roads. It is important to implicitly consider alternative routes for road users' are available. Hence, in this revalidation study, the traffic volume levels forecasted explicitly consider likely diversions and hence suppression of demand, as road users shall maximise benefits by performing less trips. With these considerations alternative traffic forecasts were made. The adopted forecast for financial analysis is suppressed demand alternative (Table B.4-4).

**Table B.4-4: Projected Traffic Volume by Alternate Considerations**

Link Name	Study	Year	Sc/Mc	Auto Rickshaw/ Chakda	Car/ Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle- Rikshaw	Animal Drawn Vehicles	Others	AADT (VEH)	AADT PCUs
Dhrol - Jamnagar	SOS-II	2006	2244	923	213	1226	135	494	319	968	1792	295	40	24	135	4	12	1	8825	15717
		2010	2521	1057	243	1483	154	597	366	1150	2163	362	41	25	146	4	12	1	10327	18671
		2015	3068	1298	299	1985	177	727	446	1468	2827	484	42	25	164	4	13	1	13029	23812
		2020	3732	1595	367	2656	204	884	542	1874	3695	648	44	26	185	4	13	2	16471	30429
		2025	4763	2026	467	3725	230	1050	686	2507	5086	917	52	31	212	5	14	2	21773	40661
	Revalidation Study - Trend based	2006	2452	1041	247	2015	224	732	528	1625	2211	576	77	22	45	6	3	6	11810	22539
		2010	2760	1194	284	2450	257	890	611	1957	2739	717	79	23	49	6	3	7	14024	27211
		2015	3357	1467	349	3278	295	1082	746	2522	3650	968	81	23	55	6	3	8	17892	35114
		2020	4184	1802	428	4387	334	1286	944	3375	5024	1371	97	28	62	6	3	9	23339	46617
		2025	5340	2289	544	6150	378	1527	1193	4517	6915	1941	116	33	71	7	3	11	31034	62520
	Revalidation Study - Supressed Demand	2006	2452	1041	192	1487	157	519	382	1157	1553	404	77	22	45	6	3	6	9502	16810
		2010	2664	1146	214	1706	175	606	423	1295	1768	461	78	22	48	6	3	6	10625	18953
		2015	3059	1325	253	2096	196	710	487	1510	2104	553	80	23	53	6	3	7	12465	22286
2020		3572	1532	298	2575	216	815	575	1802	2555	684	91	26	58	6	3	8	14815	26637	
2025		4242	1813	361	3270	239	936	678	2150	3102	845	103	29	65	7	3	9	17851	32056	
Jamnagar - Vadinar	SOS-II	2006	1384	767	267	2576	298	496	287	1637	2362	365	40	12	192	2	7	7	10698	20852
		2010	1555	878	305	3115	341	600	329	1944	2852	447	41	12	208	2	7	8	12645	24870
		2015	1891	1078	375	4169	391	730	401	2481	3728	599	42	13	234	2	7	9	16151	31907
		2020	2301	1324	461	5579	449	888	488	3167	4872	801	44	13	263	2	8	11	20670	41007
		2025	2937	1682	585	7825	507	1055	616	4238	6706	1134	52	16	302	2	8	13	27678	55153
	Revalidation Study - Trend based	2006	1968	930	441	3268	524	866	277	2574	3042	740	107	46	12	2	3	34	14833	30651
		2010	2215	1067	506	3978	601	1051	320	3078	3773	948	109	47	12	2	3	38	17750	37141
		2015	2695	1311	622	5324	690	1279	390	3939	5035	1317	113	48	14	2	3	44	22825	48134
		2020	3358	1610	764	7125	781	1520	493	5272	6930	1864	135	57	16	3	3	51	29981	64070
		2025	4286	2045	970	9973	883	1807	623	7055	9540	2639	161	68	18	3	3	61	40135	86142
	Revalidation Study - Supressed Demand	2006	1968	930	309	2377	367	614	200	1849	2154	518	107	46	12	2	3	34	11489	22605
		2010	2138	1024	345	2730	409	718	221	2061	2454	602	109	46	12	2	3	37	12913	25541
		2015	2455	1184	407	3354	457	840	254	2393	2921	735	111	47	13	2	3	41	15219	30090
		2020	2867	1369	480	4120	505	965	300	2855	3547	907	126	54	15	2	3	45	18162	36007
		2025	3405	1620	581	5227	558	1109	354	3408	4308	1121	142	61	17	3	3	51	21967	43374

36. The traffic volume by sections is forecasted by growth rate approach. The growth rates considered are moderate. They are considered by based on findings of Updated SOS of GSHP. The total traffic volume is categorized and growth rates<sup>9</sup> are adopted (as given below):

**Table B.4-5: Trend Based Growth Rates**

Mode	Region	Saurashtra				India			
		2006-10	2010-15	2015-20	2020-25	2006-10	2010-15	2015-20	2020-25
Scooter/Motor Cycle		2.1	2.8	3.2	3.5	4.2	4.2	4.2	4.2
Auto Rickshaw/ Chakda		2.5	2.9	2.9	3.4	2.9	2.9	2.9	2.9
Car/ Jeep (OT)		2.8	3.4	3.4	3.9	3.4	3.4	3.4	3.4
Car/ Jeep (NT)		3.5	4.2	4.2	4.9	4.2	4.2	4.2	4.2
Mini Bus		2.8	2.2	2.0	2.0	2.2	2.2	2.2	2.2
Standard Bus		4.0	3.2	2.8	2.8	3.2	3.2	3.2	3.2
Tempo/ LCV		2.5	2.8	3.4	3.4	3.6	3.6	3.4	3.4
2-Axle Truck		2.7	3.0	3.6	3.6	3.9	3.9	3.6	3.6
3-Axle Truck		3.0	3.3	4.0	4.0	4.3	4.3	4.0	4.0
MAV		3.2	3.6	4.3	4.3	4.7	4.7	4.3	4.3
Tractor with Trailer		0.4	0.4	2.5	2.5	2.7	2.7	2.5	2.5
Tractor without Trailer		0.4	0.4	2.5	2.5	2.7	2.7	2.5	2.5
Cycle		1.6	1.9	1.9	2.2	1.9	1.9	1.9	1.9
Cycle Rickshaw		0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.5
Animal Drawn		0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4
Others		1.8	2.1	2.1	2.5	2.1	2.1	2.1	2.1

37. The traffic volume levels thus derived are (Table B.4-6) given under in form of summary.

**Table B.4-6: Traffic Volume Levels Projected**

		2006	2010	2020	2030
Rajkot-Dhrol	Vehicles	9755	10888	15170	22096
	PCU	15141	17071	23992	34816
	Growth Rate		2.8%	3.4%	3.8%
Dhrol-Jamnagar	Vehicles	9502	10625	14815	21531
	PCU	16810	18953	26637	38610
	Growth Rate		2.8%	3.4%	3.8%
Jamnagar-Vadinar	Vehicles	11489	12913	18162	26599
	PCU	22605	25541	36007	52298
	Growth Rate		3.0%	3.5%	3.9%

38. The detailed statements on mode wise traffic levels by locations and their forecast are given at Annexure B-4.

<sup>9</sup> .The Growth rates adopted are specific to the corridor and they are considered low to be conservative side, to overcome the likely risks of diversion of traffic because of disutility posed to road users by imposing tolls. In this specific case although one does not see any potential corridor which can attract trips, the unpredictability of road users towards maximizing their benefits is perceived to be a likely risk. Hence, conservative growth rates were used.

### **B.4.3 Engineering Studies and Investigations**

#### **B.4.3.1 Alignment Verification**

39. The alignment verification for Rajkot – Jamnagar – Vadinar road corridor was done. For this purpose all the available alignment details from earlier studies along with Gujarat State Highway Project (GSHP) were studied.

40. As the pre-feasibility reports were referred to. On Rajkot – Jamnagar it was the Interim Report and in case of Jamnagar – Vadinar section it was the same DFR. Both reports did not give in any sufficient detail about the alignment. In fact some schemes are contradictory to the developments through GSHP. Towards undertaking task the GSHP improvements which are nearing completion now are taken into consideration and have been taken as the basis for further improvement schemes and design.

41. Accordingly GSHP design drawings were collected and the corridor was inspected. Considering GSHP developments further improvement scheme was finalised looking to present ground condition.

#### **B.4.3.2 Strip Mapping**

42. As detailed above, according to contractual stipulations providing linear diagrams in term of strip map is the revalidation study task but for Rajkot – Jamnagar corridor strip maps are not available. Jamnagar – Vadinar section available strip maps were used. Following details were followed for updating latest ground information alongside study corridor:

- (a) Rajkot – Jamnagar: GSHP design drawings
- (b) Jamnagar bypass : Earlier study strip maps
- (c) Jamnagar – Vadinar: GSHP design drawings

43. The latest field data was gathered through detailed strip mapping survey. Elaborate strip maps (based on GSHP design drawings where available) were prepared indicating existing and proposed scenario.

44. As desired by GSRDC, strip maps were got prepared early and submitted for further needful actions during project study.

#### **B.4.3.3 Highway Geometrics**

45. After reviewing the earlier study details the geometrics as provided in GSHP, where applicable are adopted for new proposed four-lane facility.

#### **B.4.3.4 Pavement Design**

46. Collected and reviewed feasibility study and GSHP pavement design details. Taking these as references new pavement design is carried out considering latest traffic volumes and the VDF values computed for this corridor based on fresh studies.

### **B.4.4 Design and Project Cost**

#### **B.4.4.1 Geometric Design**

47. Geometric design standards are adopted as per GSHP and IRC standards.

48. The adopted typical cross sections are placed at Annexure B-5.

#### B.4.4.2 Pavement Design

49. **VDF:** The VDF got computed after fresh Axle Load survey near Paddhari. The adopted VDF values for computation of MSA are:

LCV	–	0.54
Bus	–	1.13
2-Axle Truck	–	8.43
3-Axle Truck	–	8.25
Multi Axle Truck	–	8.63

50. **CBR:** Design CBR values are adopted from GSHP pavement design:

Section Name	Design CBR
Rajkot – Dhrol	12%
Dhrol – Jamnagar – Vadinar	7%

51. **New Pavement Design:** For design of new pavement IRC-37:2001 was followed. The design life is taken as 20 years. Average growth of commercial vehicles is considered as 5.2%. For two different sections respective maximum, directional, traffic is considered for calculation of design lane MSA. Lane distribution factor as stipulated was considered.

52. New pavement design crust for Rajkot – Jamnagar – Vadinar road corridor is tabulated as under:

Rajkot – Dhrol		Dhrol –Vadinar	
CBR – 12%		CBR – 7	
MSA – 200		MSA – 350	
Adopted Design for CBR 12%, MSA – 150*		Adopted Design for CBR 7, MSA – 150 <sup>10</sup>	
	<b>Required</b>	<b>Recommended</b>	
BC	50	50	
DBM	150	100	
WMM	250	360 <sup>11</sup>	
GSB	200	200	
<b>Total</b>	<b>650 mm</b>	<b>710 mm</b>	
			<b>Required</b>
			<b>Recommended</b>
			50
			165
			250
			230
			<b>695 mm</b>
			<b>780 mm</b>

# Substitution of pavement layers as per IRC:37-2001 and IRC:81-1997.

#### B.4.4.3 Overlay and Profile Correction

53. Wherever GSHP improved facility is in place it was thought appropriate to have only profile corrective course to get unidirectional camber. BBD survey<sup>12</sup> was additionally envisaged to estimate the near accurate cost and structural overlay requirement.

<sup>10</sup> As stipulated by IRC:37 – 2001, “For traffic exceeding 150 msa, the pavement design appropriate to 150 msa may be chosen and further strengthening carried out to extend the life at the appropriate time based on pavement deflection measurements as per IRC:81.

<sup>11</sup> Substitution of pavement layers as per IRC:37-2001 and IRC:81-1997.



54. Based on current practices, overlay design has been made for project cost estimation. Modifications as needed in design on having inputs from BBD analysis will be incorporated in to the Final Report.

55. At present following scheme has been adopted:

- Profile correction with BM – Average 50mm thick
- Overlay – DBM – 80mm, BC – 40mm

#### B.4.4.4 Structures Design

56. Generally the new structures are proposed similar to that of GSHP. Details pertaining to existing structures and proposed scheme for four laning is placed at Annexure B-6. Based on these rates adopted for various structure items are:

Sl. No.	Description	Unit	Rate (Rs.)
1	Major Bridges	Sqm	26,000/-
2	ROB	Sqm	26,000/-
3	Minor Bridges	Sqm	24,000/-
4	Slab Culverts	Sqm	18,000/-
5	Box Culverts	Sqm	18,000/-
6	Pipe Culverts (Single Row)		
a	Diameter $\geq$ 0.90m	Rm	7,500/-
b	Diameter $>$ 0.75m & $<$ 0.60m	Rm	6,500/-
c	Diameter $\leq$ 0.60m	Rm	5,500/-

#### B.4.4.5 Project Cost

57. **Rates Adopted:** The schedule of rates<sup>13</sup> of the National Highway – Rajkot Division (NH-Rajkot) were used for estimating cost of the project.

58. Where required escalation was applied, also for some of the items realistic rates were evaluated and used.

59. Base year construction cost worked out as:

Sl. No.	Description of Item	Total Amount (in million Rs.)
1	Highway Cost	2738.16
2	Intersections, Toll Plaza, Bus Bay/Bus Shelters	383.68
3	Structure Cost	1240.22

<sup>12</sup>. On review of some specific minor/major distresses, the Secretary, R&BD advised for conducting BBD surveys in addition to present scope for ensuring adequacy of structural strength and design of overlays. The work on BBD is currently in progress.

<sup>13</sup>. This was discussed with GSRDC. It was advised that Rates of Rajkot NH - Division are followed. Escalation where required was applied.

Sl. No.	Description of Item	Total Amount (in million Rs.)
4	Existing Road Maintenance	31.53
<b>Total Construction Cost</b>		<b>4393.59</b>

60. Details pertaining to quantity and cost calculation are placed at Annexure B-7.

#### B.4.5 Environmental and Social Impact Assessment

61. The Project Corridor Rajkot-Jamnagar-Vadinar is spread out in five talukas of two districts with a total population of 2.25 million and area of 4629 km<sup>2</sup> as per 2001 Census. Project Corridor traverses through two talukas in Rajkot district with a total length of 35 km, whereas corridor traverses through three talukas over a length of 101.3 km in Jamnagar district. Jamnagar, Paddhari and Khambhaliya are the talukas which are likely to be affected the most and Rajkot (12 km of the Project corridor passes through this taluka) - the least (Table B.4-7).

**Table B.4-7: Propensity of Impacts (By Taluka)**

District	Taluka	Area (km <sup>2</sup> )	Length of Corridor (km)	Population
Rajkot	Rajkot	1072.25	12	1137984
	Paddhari	599.34	23	73092
		<b>1671.6</b>	<b>35.0</b>	<b>1211076</b>
Jamnagar	Dhrol	569.89	23	74943
	Jamnagar	1173.91	59.2	761375
	Khambhaliya	1213.98	19.1	208739
		<b>2957.8</b>	<b>101.3</b>	<b>1045057</b>
<b>Total</b>		<b>4629.4</b>	<b>136.3</b>	<b>2256133</b>

62. Khambhaliya is the largest with an area of 1213 km<sup>2</sup> (26.22% of total area of Talukas being traversed) and Dhrol is the smallest, with only 569 km<sup>2</sup> (12.31%). Population size vary between 73,000 in Paddhari to 1,137,000 Rajkot. They show wide variation. Rajkot has the highest share of population (50.43 % of all Talukas being traversed) covering five Talukas.

63. **Impacts on Flora:** No significant natural vegetation communities will be affected by the widening of the road to four lane. There are no rare or endangered species among these plantations. The tree species found are banyan, neem and copperpod. To ease construction of the embankment for the widened road formation and to permit construction of adequate roadside drainage structure, trees located within the area between the pavement and the "daylight line" need to be removed (Table B.4-8).

**Table B.4-8: Tree Plantation along The corridor**

Name	No. of Trees	No. of Trees to be impacted
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Rajkot-Dhrol	225	150
Dhrol-Jamnagar Bypass	50	34
Jamnagar Bypass	100	82
Jamnagar-Vadinar	140	77
<b>Total</b>	<b>515</b>	<b>343</b>

64. **Bio-diversity and endangered species:** No threatened or endangered species will be affected along the road. Neither any construction activity occurs through any habitats of endangered species nor will increased traffic volumes and speeds have any affect on endangered wildlife.

65. **Impacts on Fauna:** There are 20 wildlife sanctuaries and 4 national (wildlife) parks in Gujarat, covering an area of 16,902.38 km<sup>2</sup>. The list of the sanctuaries and national parks near to the corridor is presented in Table B.4-9.

**Table B.4-9: Sanctuaries and National Parks**

Name	Status	Location	Area (km <sup>2</sup> )	Major Wildlife
Marine Park	National Park	Jamnagar	162.89	Corals and fish; Black Cornalia; Dolphin
	Sanctuary		295.03	
Khijadia	Sanctuary	Jamnagar	6.05	A variety of migratory and water birds.
Gaga	Sanctuary	Jamnagar	3.33	Great Indian bustard, Lesser Florican, Damoiselle Crane.
Rampara	Sanctuary	Rajkot	15.01	Panther, Nilgai, Chinkara, Wild Boar, Wolf, Pangoline.

66. The Marine National Park and Sanctuary, at the Jamnagar coast, is more than 5 km from the corridor. However the highway is too far to cause any from of contamination in the sanctuary. The Khijadia Bid Sanctuary is 4-6 km from Vanthli-Jamnagar road. It is the abode of migratory birds. Also a few birds while migrating use this area as a stop over. Thus, there will not be an increase in severance of any wild fauna habitat due to the proposed road widening measures. No endangered or precious fauna was recorded within the RoW.

67. **Impacts on Cultural Environment:** Strip mapping carried out on the project corridors was the main source of identification of the affected cultural properties falling within and just outside the RoW of the project corridors. A temple of Goddess Krishna based at Dwarkadhis is about 80 km away from the corridor near Vadinar approach. The Swami Narayan mandir in Gondal, the Jalaram temple in Virpur and Swami Dayanand's birthplace, Tankara, are pilgrim centres in Rajkot district (Table B.4-10).

**Table B.4-10: Archaeological Monuments/Sites within 10 km of Project Corridors**

Name	Location	Description
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Monuments	Dwarka	Dwarakapuri, Dwarkadhish temple, Behind Bhanjan Mahadev, Naganth Mahadev, Ashapurimata, Daooji –ni-Haveli, Shri Krishna – Pranami Mandir are the famous temples.
Monuments	Jamnagar	Ranjit sagar dam a specimen of fine architecture and the samshan. lakhota, the khoto, the sixteenth century temple of Nagnath Mahadev situated on the Nagmati river and the Kalika mata temple.
Monuments	Khambhaliya	The khambalia gate belongs to 19 <sup>th</sup> century, while the Chalukyan stepwell and the Ra Kumbha Darbar belong to the mediaeval times.

68. Cultural properties lying along the highways are most susceptible to impacts due to construction activities depending upon the access to the property, distance between the road pavement and the cultural property, the condition and scale of the built structure. (Figure B.4-2) Road construction machinery operating during the construction phase is likely to require a belt of about 4-5m from the edge of the carriageway. In such instances cultural properties located within a distance of 5m from the edge of the carriageway, risk being damaged by the heavy machinery (Table B.4-11).



**FigureB.4-2: Temple liable to be relocated**

**Table B.4-11: Cultural Properties along Project Corridors**

Change	Place	Cultural properties	Side	Dist from Edge of CW	Condition	Environment
5.4	Rajkot	Shrine		8	Average	Urban
6.645	Rajkot	Dargah	L	6.7	Average	Urban
21.2	Paddhari	Temple	L	12	Average	Urban
40.35	Dhrol	Shrine		7.2	Good	Semi Urban
68.8	Falla	Shrine	L	3.5	Average	Urban
73.88	Banugar	Shrine	R	0.9	Good	Rural
74.9	Banugar	Shrine	R	4.2	Average	Rural
76.41	Banugar	Shrine	R	3	Average	Rural
77.41	Bypass	Temple	R	10	Average	Rural
78.4	Bypass	Temple	R	12	Average	Rural
88.36	Markanda	Temple	R	18	Good	Rural
91.1	Lalpur Cross road	Temple	L	15	Average	Rural
91.52	Lalpur Cross road	Temple	L	7	Good	Rural
95.55		Ramdev Ashram	R	10.2	Good	Rural
104	Vasai	Cheria Dada Dargah	R	9	Average	Rural
107.3	Bedgaam	Mahadev Temple	R	6.3	Average	Rural
109.39		Ramroti Ashram	R	9.45	Average	Rural
109.09		Shrine	R	9	Average	Scrub
111.26		Shrine	R	10.9	Average	Agriculture
116.458		Shrine	R	15	Average	Semi Urban

Change	Place	Cultural properties	Side	Dist from Edge of CW	Condition	Environment
120.558		Shrine	R	2.3	Average	Rural
120.8		Shrine	R	3.81	Average	Semi Urban
1.9	Vadinar approach	Temple	R	25	Average	Rural
3.9	Shingaj	Temple	R	15	Average	Rural
7.24	Shingaj	Temple	L	22	Average	Rural
7.24	Shingaj	Temple	R	12	Average	Rural
7.8	Shingaj	Dargah	R	17	Average	Rural

69. **Land Acquisition:** Widening from two lane to four lane of the roads might require acquisition and clearing of various types of properties. AS the design of the proposed road widening is within the existing RoW, limited land acquisition is assessed to be required in this Project corridor. The details of such land acquisition needs by segment of road corridor are as given in Table B.4-12.

**Table B.4-12: Properties Likely to be impacted in Project (area in Ha)**

Type of Land Acquisition	Rajkot-Dhrol	Dhrol-Jamnagar Bypass	Jamnagar Bypass	Jamnagar-Vadinar approach	Total Area in Ha
Agricultural in Ha	22.61	5.60	17.35	12.67	<b>58.23</b>
Residential in Ha	0.08	0.02	0.07	0.02	<b>0.18</b>
Commercial in Ha	0.25	0.01	0.72	0.04	<b>1.02</b>
Open in Ha	13.30	1.17	3.75	4.99	<b>23.21</b>
Barren in Ha	25.55	12.87	5.23	0.21	<b>43.86</b>
Industry in Ha	0.26	0.22	0.06	0.00	<b>0.54</b>
Plantation in Ha	0.66	0.00	0.00	0.00	<b>0.66</b>
Community in Ha	0.02	0.00	0.00	0.01	<b>0.04</b>
<b>Total area in Ha</b>	<b>62.73</b>	<b>19.88</b>	<b>27.18</b>	<b>17.94</b>	<b>127.73</b>

70. Vasai village, at km 104, is a small village with a very constrained RoW. Refer Figure B.4-3. The road passes close to a dense settlement in Vasai village at but there is no scope for widening at that location. Bypass is considered as the only option to avoid resettlement and relocation of community facilities.

71. **Impacts on Water Resources:** A road project can significantly alter the hydrological setting of an area and add to the siltation and pollution level in water sources. The identification and mitigation of such adverse impacts assume greater significance in water scarce regions such as Gujarat.



**Figure B.4-3: Congestion at Vasai Village**

72. **Surface water:** Dodi River crosses the corridor at 27.8km and River Wond, dry most of the year crosses at km 56 in Rajkot Jamnagar corridor. There are no major water bodies or wetlands that might be directly or indirectly impacted as a result of the project.

73. **Water resources along the project corridors:** Widening of road can have a wide range of effects on water resources stemming from activities such as earth-moving, removal of vegetation, vehicle/machine operation and maintenance, handling and laying of asphalt, sanitation and waste disposal at labour camps. Removal of trees and vegetation can lead to erosion of soil and siltation of water bodies. There is a couple of wells, at km, 97.9 and 103.1, which are located close to the existing pavement. Sediment load from road run-off and potential of collision with vehicles are the concerns associated with the construction phase. During the operational phase contamination due to run-off lubricants and exhaust emissions is likely impact. Refer Table B.4-13 for the numbers and categories of water bodies likely to be impacted by the project.

**Table B.4-13: Water bodies likely to be impacted by Project**

Link Name	Water Body		Likely impacts
	Pond	Well	
Rajkot-Dhrol	1	3	Sedimentation. Impact is minor.
Dhrol-Jamnagar Bypass	1	2	Sedimentation. Impact is minor.
Jamnagar Bypass	1	2	Sedimentation. Impact is minor.
Jamnagar-Vadinar	2	4	Sedimentation. Impact is minor.
<b>Total</b>	<b>5</b>	<b>11</b>	

#### B.4.6 Tollable Traffic

74. The vehicles which are tollable<sup>14</sup> as per the Concession agreements are considered for assessment of tollable traffic in the base year. From the road side interview conducted, the desire of traffic, as noted earlier, was recorded (as sample basis). In this study, all the intra zonal and inter-zonal trips, of the zones lying on the corridor are excluded. This exclusion may lead to slightly under estimation of tollable traffic. It is felt prudent to exclude traffic of the influence area in assessment of tollable traffic. Further it is felt appropriate that the drop by 30% of assessed of total tollable traffic (from the trend based approach) to establish Tollable traffic on project sections for further analysis to minimise risk of traffic realisation and optimism on commercial viability of project.

75. The assessed tollable traffic by sections and by mode is given in Table B.4-14.

**Table B.4-14: The Assessed Base year Tollable traffic by Modes and Sections**

Corridor Name	Composition	Link Name	Cars (OT)	Cars (NT)	Mini Buses	Buses	Lcv/ Tempo	2-Axle	3-Axle	M-Axle	TOTAL AADT (VEH)
Rajkot-Jamnagar-Vadinar	Total	Rajkot-Dhrol	190	1814	136	417	536	1081	1023	318	<b>5515</b>
	Non-Tollable	Rajkot-Dhrol	120	607	85	9	178	133	24	11	<b>1167</b>
	Tollable	Rajkot-Dhrol	70	1207	51	408	358	948	999	307	<b>4348</b>
Rajkot-Jamnagar-Vadinar	Total	Dhrol-Jamnagar	192	1487	157	519	382	1157	1553	404	<b>5850</b>
	Non-Tollable	Dhrol-Jamnagar	63	255	0	20	41	65	18	2	<b>465</b>
	Tollable	Dhrol-Jamnagar	129	1232	157	498	341	1092	1535	402	<b>5386</b>
Rajkot-Jamnagar-Vadinar	Total	Jamnagar-Vadinar	309	2377	367	614	200	1849	2154	518	<b>8387</b>
	Non-Tollable	Jamnagar-Vadinar	0	298	0	27	20	158	81	0	<b>584</b>
	Tollable	Jamnagar-Vadinar	309	2079	367	587	180	1691	2073	518	<b>7803</b>

<sup>14</sup> Only cars and commercial vehicles which include buses are tollable.



76. The forecasted tollable traffic, by mode and sections at 10 year interval is given at Table B.4-15. This forecast is based on growth rate approach. Annexure B-8 provides link wise tollable traffic projections.

**Table B.4-15: The Assessed Base year Tollable traffic by Modes and Sections**

Link Name	TOLL PLAZA No	Chainage (Km)	Year	Cars (OT)	Cars (NT)	Mini Buses	Buses	Lcv/ Tempo	2-Axle	3-Axle	M-Axle	TOTAL AADT (VEH)	TOTAL AADT (PCU)
Rajkot-Dhrol	1	29/000	2006	70	1207	51	408	358	948	999	307	4348	10362
Rajkot-Dhrol	1	29/000	2010	79	1385	57	477	395	1060	1139	361	4954	11826
Rajkot-Dhrol	1	29/000	2020	109	2090	71	641	536	1474	1649	551	7120	16915
Rajkot-Dhrol	1	29/000	2030	161	3372	86	845	745	2099	2432	841	10580	24734
Rajkot-Dhrol	1	29/000	2040	236	5440	105	1113	1037	2990	3585	1284	15791	36286
Dhrol-Jamnagar	2	60/000	2006	129	1232	157	498	341	1092	1535	402	5386	13369
Dhrol-Jamnagar	2	60/000	2010	144	1414	175	583	378	1222	1748	459	6123	15198
Dhrol-Jamnagar	2	60/000	2020	201	2134	216	783	513	1701	2525	680	8754	21626
Dhrol-Jamnagar	2	60/000	2030	295	3440	263	1033	714	2423	3724	1038	12930	31543
Dhrol-Jamnagar	2	60/000	2040	432	5547	321	1361	994	3451	5491	1585	19182	46154
Jamnagar-Vadinar	3	106/200	2006	309	2079	367	587	180	1691	2073	518	7803	18774
Jamnagar-Vadinar	3	106/200	2010	345	2389	409	686	199	1884	2362	602	8877	21360
Jamnagar-Vadinar	3	106/200	2020	480	3604	505	923	270	2612	3417	907	12719	30438
Jamnagar-Vadinar	3	106/200	2030	705	5798	616	1218	376	3720	5039	1385	18856	44461
Jamnagar-Vadinar	3	106/200	2040	1035	9329	750	1607	524	5298	7430	2114	28088	65170

77. In addition to above, estimated tollable traffic is forecasted at 2% p.a. up to "COD" and 5% thereafter<sup>15</sup> the forecasted traffic by mode is given as Annexure B-9.

### B.4.7 Financial Analysis

78. The financial analysis of the project has been undertaken to assess the viability of the projects under a commercial format. A number of options/scenarios of project have been worked out to aid in decision-making process. The following scenarios have been considered for undertaking the financial analysis:

- Scenario 1:** Rajkot Jamnagar Vadinar as one corridor (137.3km);
- Scenario 2:** Rajkot to start of Jamnagar bypass (75.5km);
- Scenario 3:** Jamnagar Bypass to Vadinar (61.6km).

#### B.4.7.1 Inputs and Assumption

##### Revenue Model

<sup>15</sup> This is based on new model concession agreement of GoI.

- (a) **Tollable Traffic:** The tollable traffic, by each toll plaza, has been estimated and presented in Sub-Section B.4.6. This traffic forms an input to the financial analysis.
- (b) **Toll Rates:** The toll rates are those which have been recommended by the Ministry, vide a notification in the year 1997. These have been escalated to prices as on 31<sup>st</sup> March 2006. The per km toll rates as well as the toll rate for the project corridor, at 2006 prices, have been given in Table B.4-16.

**Table B.4-16: Toll Structure (at 2006 prices)**

Mode	Toll Rate (Rs./km at 2006 price)	Toll Rates (Rs./Trip at 2006 price)		
		Rajkot Jamnagar Vadinar	Rajkot to start of Jamnagar bypass	Jamnagar Bypass to Vadinar
Car/Jeep	0.61	85	45	40
Mini Bus	1.07	145	80	65
Bus	2.13	295	160	130
LCV	1.07	145	80	65
2-Axle Truck	2.13	295	160	130
MAV	3.43	470	260	210

For future, the toll rates have been assumed to increase at an inflation rate of 5% p.a. For estimation of corridor level toll rate, this has been rounded to nearest five rupee.

- (c) **Annual Toll Collection:** The annual toll revenue realisation, over the project period, at current prices, has been given in Table B.4-17:

**Table B.4.17: Annual Toll Revenue**

Year	Annual Toll Collection (Mill Rs at current Prices)		
	Rajkot Jamnagar Vadinar	Rajkot to start of Jamnagar bypass	Jamnagar Bypass to Vadinar
2010	812.9	367.2	488.7
2015	1238.9	555.5	749.5
2020	1907.0	860.4	1147.0
2025	2935.0	1326.3	1763.8
2030	4539.7	2039.1	2721.2
2035	7007.0	3166.9	4212.3

### Cost of Project

79. The initial civil cost of project has been estimated as follows by each scenario:

- (a) Scenario 1 : Rs 4393.6 mill  
(b) Scenario 2 : Rs 2410.96 mill  
(c) Scenario 3 : Rs 1972.6 mill

80. The construction activities have been assumed to be undertaken in the years 2008 and 2009. The total cost of project is as follows:

(in Mill Rs)



Type of Cost	Rajkot Jamnagar Vadinar	Rajkot to start of Jamnagar bypass	Jamnagar Bypass to Vadinar
Civil Construction Cost	4393.6	2420.96	1972.6
Contingency (10%)	439.3	242.1	197.3
Construction Supervision (3%)	144.99	79.89	65.1
Inflation During Construction	661.16	364.31	296.85
Total Cost of Project	5639.1	3107.26	2531.84

81. Routine and periodic maintenance have been taken as follows:

Routine Maintenance – Rs. 40,000/km

Periodic Maintenance – Rs. 3 mill/km

#### *Assumptions for Analysis*

82. A number of assumptions have been considered for the analysis. They have been listed below:

- (a) The base debt-equity ratio has been taken as 7:3.
- (b) The analysis period has been taken as 30 years.
- (c) The rate of interest considered for the analysis has been assumed as 12% p.a. This is looking at the present increase in interest rates.
- (d) With respect to the increased interest rates, the expected post-tax return on investment has also been taken at a value of 15 – 17%.
- (e) The subsidy/grant component has been limited to 40% of the total project cost. Under the VGF scheme, a maximum of 20% of the total project cost is expected to come from the central government and the balance, if any, needs to be given by the state government.
- (f) The disbursement of VGF has been taken during the construction period. It is to be disbursed after the equity draw-down by the concessionaire in over. The phasing of VGF/capital grant has been linked to the debt draw-down.
- (g) The Corporate Tax is taken at 33.66%<sup>16</sup>. In the event of the tax rebate, a Minimum Alternative Tax of 11.22 %<sup>17</sup> has been included in the analysis.
- (h) The depreciation schedule has been taken as per the IT and Companies Act.
- (i) Insurance premium has been assumed at 0.7% of the assets/investment.
- (j) The tax concession on road projects has been taken for the analysis. There is a 10 year, full tax rebate on road infrastructure projects, starting from the first year of operation of the same.
- (k) The loan repayment period has been assumed as seven years after two years of moratorium.

<sup>16</sup> The breakup is 30% Corporate Tax, with 10% surcharge and 2% education cess.

<sup>17</sup> The MAT is 10% with 10% service tax and 2% education cess.

**B.4.7.2 Results of Financial Analysis- Base Case: Realistic Traffic**

83. The financial analysis for the base case has been presented in the Table B.4-18 as summary. The details of financial analysis are presented through Annexure B-10.

**Table B.4-18: Results of the Analysis in Base Case**

Indicators	Rajkot Jamnagar Vadinar		Rajkot to start of Jamnagar bypass		Jamnagar Bypass to Vadinar	
	20 Yrs	30 Yrs	20 Yrs	30 Yrs	20 Yrs	30 Yrs
Viability Gap Funding mill Rs	845	-	1242.9	621.5	-	-
% of Project Cost	15%	-	40%	20%	-	-
Pre-Tax IRR (%)	18.50	18.54	18.16	18.36	21.39	22.94
Post-Tax IRR (%)	17.12	17.03	17.00	17.02	19.28	20.83
Return on Equity (%)	20.37	18.24	21.46	18.35	24.93	26.33
Minimum DSCR	0.57	0.46	-ve	-ve	0.86	
Average DSCR	1.11	0.93	1.47	1.05	1.34	
Payback Period	10 yrs 2 mths	12 yrs 2 mths	12 yrs	14 yrs	8 yrs 5 mths	

84. If the project corridor as a whole is implemented under the BOT, it is not likely to require any support in form of equity or O&M for project viability over 30 year time period. However if the concession period is reduced to 20 years, then the VGF of 15% (Rs 845 mill) of project cost is required for making the project attractive for a private operator.

85. In case only Rajkot to start of Jamnagar Bypass is taken as one BOT contract, then VGF is required for making the project viable. On the other hand if Jamnagar to Vadinar along with the Jamnagar bypass is taken up for implementation separately, there is no need for governmental support for making the project viable.

**B.4.7.3 Sensitivity Analysis: Variation in Revenue and Cost**

86. In order to understand the sensitivity of variation in revenue and cost levels on the project viability, a case of increased and reduced cost and toll revenue realisation, respectively, has been worked out and the results are presented in Table B.4-19.

**Table B.4-19: Sensitivity Analysis: Increase in Cost & Reduction in Revenue (30 Year)**

Indicators	Rajkot Jamnagar Vadinar			Rajkot to start of Jamnagar bypass			Jamnagar Bypass to Vadinar		
	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost
Viability Gap Funding mill Rs	972.7	1127.8	1880.6	1072.0	1087.5	1679.5	-	-	87.3
% of Project Cost	15%	20%	29%	30%	35%	47%	-	-	3%
Pre-Tax IRR (%)	18.66	18.82	18.43	18.16	18.17	18.58	20.92	20.43	18.98
Post-Tax IRR (%)	17.20	17.36	17.02	16.89	16.92	17.09	19.13	18.66	17.28
Return on Equity (%)	18.71	19.08	18.42	18.15	18.07	18.57	23.21	22.13	19.08
Minimum DSCR	0.47	0.38	0.36	-ve	-ve	-ve	0.75	0.64	0.56
Average DSCR	0.95	0.96	0.93	1.02	1.01	1.08	1.17	1.12	0.99
Payback Period	12 yrs 2 mths	12 yrs 2 mths	12 yrs 8 mths	14 yrs 4 mths	14 yrs 7 mths	16 yrs 4 mths	9 yrs 4 mths	9 yrs 9 mths	11 yrs 6 mths

87. Full corridor, if can be taken up as one contract, makes the project robust, of course with VGF support. The section from Rajkot to start of Jamnagar bypass needs to be considered under more than 20 year concession period option. The most profitable section on this corridor is Jamnagar to Vadinar, along with the bypass section. It is combining of this section with the rest of the corridor that will make the total corridor from Rajkot to Vadinar attractive for investors.

#### B.4.7.4 New Model Concession Agreement as Base

88. The Committee on Infrastructure has recently prepared a New Model Concession Agreement, for the upcoming BOT projects. Anticipating the implementation of the same, a set of analysis has been undertaken with the new MCA as the base as well. The major assumptions, beyond the ones already stated, which have been incorporated in this analysis as per the new MCA are:

- The traffic growth has been considered at 5% per annum over the concession period, starting from the COD. However, from the base year to the year when the construction is completed, the traffic growth has been taken as 2% per annum.
- In case the project corridor qualifies for a six-lane, within the project period, the concession period has been limited to a maximum of that many years.

89. The results of the analysis summary have been presented in Table B-4-20.

**Table B.4-20: Results under New MCA Assumptions**

Indicators	Rajkot Jamnagar Vadinar	Rajkot to start of Jamnagar bypass	Jamnagar Bypass to Vadinar
Requirement of Six Lane	2022	2027	2022
Maximum Concession Period	15 Yrs	20 Yrs	15 Yrs
Viability Gap Funding			
mill Rs	1297	932.2	-
% of Total Project Cost	23%	30%	-
Pre-Tax IRR (%)	18.23	18.28	20.03
Post-Tax IRR (%)	17.1	17.13	18.64
Return on Equity (%)	22.97	21.48	25.56
Minimum DSCR	0.81	0.48	1.03
Average DSCR	1.43	1.38	1.54
Payback Period	9 yrs 1 mth	10 yrs 5 mths	8 yrs 4 mths

#### B.4.7.5 Conclusions

90. The project corridor connecting Rajkot to Vadinar via Jamnagar bypass is a commercially viable proposition. The project road being very long, the analysis has been undertaken for two possible BOT contracts as well. The results reflect that if the corridor is to be broken under two BOT packages, then section between Rajkot to start of Jamnagar bypass can be given out for a concession period of between 25 to 30 years, so as to reduce risks for the concessionaire. As for the section between Jamnagar bypass and Vadinar, the concession period can be reduced

to between 15 and 20 years. If the full corridor can be taken up as one BOT project, then the period can be kept around 20 years.

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